Literature Review

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Possible treatments for microstomy in patients with systemic sclerosis: scoping review

Possíveis tratamentos para a microstomia em pacientes com esclerose sistêmica: revisão de escopo

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ABSTRACT

Purpose: This scoping review systematically mapped the available interventions for the management of microstomia in systemic sclerosis, characterizing their features and reported clinical outcomes. **Search strategy:** The review followed PRISMA-ScR guidelines, using the Population (patients with systemic sclerosis), Concept (therapeutic interventions for microstomia), and Context (clinical and experimental studies) strategy. The search was conducted in seven databases in May 2025, utilizing both controlled and uncontrolled descriptors combined with Boolean operators. Two independent reviewers performed the screening and selection of studies, with a third reviewer consulted in case of disagreements. **Selection criteria:** Clinical studies involving adult or older adults patients with a confirmed diagnosis of systemic sclerosis were included. Review articles, commentaries, monographs, guidelines, books, recommendations, and studies involving two or more comorbidities were excluded. No restrictions were applied regarding year, language, or study type. The analysis of results was qualitative. **Results:** A total of 263 articles were retrieved, of which 24 were included in the final sample. The described interventions included orofacial myotherapy (stretching, isotonic, and isometric contraction exercises), electromagnetic radiation (ultraviolet light, intense pulsed light, and fractional CO_2 laser), surgical procedures (such as commissuroplasty and grafts), and applications of botulinum toxin, hyaluronic acid, and enzymes. **Conclusion:** The review identified a range of therapeutic approaches for microstomia in systemic sclerosis, from myofunctional exercises to invasive procedures. Despite this variety, the current scientific evidence is limited and heterogeneous, underscoring the need for well-designed clinical studies to assess the comparative effectiveness of these interventions and to inform evidence-based clinical protocols.

Keywords: Systemic sclerosis; Stomatognathic system; Microstomy; Autoimmune diseases; Speech-language pathology

RESUMO

Objetivo: mapear, por meio de revisão de escopo, as intervenções disponíveis para o tratamento da microstomia na esclerose sistêmica, descrevendo suas características e principais resultados clínicos. **Estratégia de pesquisa:** a revisão seguiu as diretrizes PRISMA *Extension for Scoping Reviews*, utilizando a estratégia População (pacientes com esclerose sistêmica); Conceito (intervenções terapêuticas para microstomia) e Contexto (estudos clínicos e experimentais). A busca foi realizada em sete bases de dados, em maio de 2025, utilizando descritores controlados e não controlados, combinados por operadores booleanos. Dois revisores independentes conduziram a triagem e seleção dos estudos, sendo um terceiro acionado em caso de divergências. **Critérios de seleção:** foram incluídos estudos clínicos realizados em pacientes adultos ou idosos com diagnóstico confirmado de esclerose sistêmica e excluídos artigos de revisão, comentários, monografias, diretrizes, livros, recomendações e estudos com duas ou mais comorbidades. Não houve restrições quanto ao ano de publicação, idioma ou tipo de estudo. A análise dos resultados foi qualitativa. **Resultados**: foram recuperados 263 artigos e 24 incluídos na amostra. As intervenções descritas incluíram: mioterapia orofacial (exercícios de alongamento, de contração isotônica e isométrica), radiação eletromagnética (luz ultravioleta, luz intensa pulsada e *laser* de CO_2 fracionado), procedimentos cirúrgicos (como comissuroplastia e enxertos) e aplicações de toxina botulínica, ácido hialurônico e enzimas. **Conclusão**: a revisão de escopo mostrou que existem diferentes estratégias terapêuticas para a microstomia em pacientes com esclerose sistêmica, variando desde exercícios miofuncionais até procedimentos invasivos. Apesar da diversidade de estudos, a evidência científica ainda é limitada e heterogênea, ressaltando a necessidade de estudos clínicos robustos que avaliem a efetividade comparativa dessas intervenções e apoiem protocolos baseados em evidências.

Palavras-chave: Esclerose sistêmica; Sistema estomatognático; Microstomia; Doenças autoimunes; Fonoaudiologia

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INTRODUCTION

Systemic sclerosis (SSc) is a rare rheumatic disease of autoimmune origin, with a currently unknown pathogenesis, characterized by immunological, vascular, and fibrotic changes in both the skin and internal organs, leading to multiple symptoms and significant disabilities for affected patients[1].

It is usually accompanied by scleroderma, the thickening and hardening of the skin; however, not everyone with ES presents with the classic cutaneous form [2]. Changes in connective tissue begin with microvascular vasoconstriction that triggers an autoimmune response, followed by ischemia, tissue and collagen loss, and the development of dermal fibrosis due to myofibroblasts' resistance to apoptosis[3].

Among its clinical manifestations, the gastrointestinal tract is the most commonly involved internal organ, and in its upper portion, it can affect the oral cavity in 30% to 70% of cases[4]. Thus, it is emphasized that oropharyngeal characteristics are common and are occasionally underestimated in treatment, despite their implications for the comfort, aesthetics, nutrition, and quality of life of these patients[5].

It is essential to highlight that, in the area of orofacial motor skills in Speech Therapy, the limitation of mouth opening (LMO) or microstomia is of particular interest, as it affects most cases[6]. This limitation is explained by different reasons that may or may not be associated, such as fibrosis of the perioral soft tissue, mandibular degenerative processes[7,8], and ischemic and vasculopathic processes, reducing local blood flow, causing muscle fibrosis, progressive degeneration, and consequently aggravating the functional limitation for mouth opening[9].

Considering the importance of orofacial manifestations in the quality of life of patients with systemic sclerosis, especially given that microstomia contributes to difficulties in eating, speaking, and oral hygiene, in addition to potentially generating anxiety and low self-esteem[10], interdisciplinary interventions are needed in these situations. Therefore, speech-language pathology clinical management of microstomia requires continuous, specialized monitoring given the disease's progressive nature[11].

In light of the above, speech therapists need to know what the possible therapeutic interventions are for interdisciplinary clinical discussion and for planning objectives and strategies based on scientific evidence. Therefore, this study aimed to map, through a scoping review, the available interventions for the treatment of microstomia in systemic sclerosis, describing their characteristics and primary clinical outcomes.

RESEARCH STRATEGIES

To conduct this research, the PRISMA guidelines for scoping reviews were followed - PRISMA *Extension for Scoping Reviews* (PRISMA-ScR)[12]. It should be noted that a preliminary search was conducted in the PROSPERO and Cochrane databases to determine whether a systematic review on the subject already existed; upon confirming its absence, the other processes were initiated. The project was registered on the Open Science Framework (osf.io/g965u).

Next, the clinical research question was formulated, outlined using the P.C.C. strategy (P for participant, C for concept, and C for context), and structured as follows: "What are the therapeutic interventions for microstomia (C – concept) in patients with a confirmed diagnosis of systemic sclerosis (P – patients with systemic sclerosis)?" The context (C) would be clinical and experimental studies.

Sources of information and search

Chart 1 presents the search strategies used in the databases. Keywords or synonyms were selected from the Health Sciences Descriptors (DeCS) and the Virtual Health Library (VHL). The electronic databases SciELO, PubMed (including MEDLINE), Latin American and Caribbean Health Sciences (LILACS), and Scopus (via the CAPES platform) were used as primary sources of study. To avoid selection and publication bias, the gray literature databases Open Theses and Dissertations (OATD) and Open Grey were also consulted. The following terms were used in English: "systemic sclerosis", "mouth opening", "therapy", "adult", "elderly", "children". To enhance the search strategy, Boolean operators (OR, AND, and NOT) were used to create combinations between the descriptors. The search in the virtual databases was conducted from May 5 to 9, 2025.

The methodology adopted involved searching for articles according to the eligibility criteria, without restrictions on status, language, or year of publication.

Selection criteria

Observational studies (such as case reports and case series, longitudinal studies, whether prospective or retrospective) and experimental studies (randomized or non-randomized clinical

Chart 1. Search strategies in the virtual databases consulted

Electronic databases	Search Strategy	Quantity of acquired collection
PubMed	((systemic sclerosis) AND (mouth opening) AND (therapy) AND (adult AND elderly NOT child))	38
LILACS	(systemic sclerosis) AND (mouth opening) AND (therapy) AND (adult) AND (elderly) NOT (child)	10
SciELO	(*systemic sclerosis) AND (mouth opening) AND (therapy)	01
Open Grey	Systemic sclerosis	16
Open Theses and Dissertations	systemic sclerosis AND mouth opening therapy	14
Scopus	systemic AND sclerosis AND mouth AND opening AND therapy	34
Google Scholar (Up to page 15)	((systemic sclerosis) AND (mouth opening) AND (therapy) AND (adult AND elderly AND NOT child))	150
Total		**263**

Subtitle: Authors

trials, experimental studies with or without a control group) conducted in adult or elderly patients with a confirmed diagnosis of systemic sclerosis and that addressed the outlined clinical question were included.

Studies identified as duplicates from searches in different databases, review articles, commentaries, undergraduate monographs, guidelines, books, chapters, recommendations or protocols, studies with two or more comorbidities associated with systemic sclerosis, studies with children, as well as studies outside the scope of the research and those that did not provide quantitative measurements of mouth opening before and after the intervention in their results were excluded.

By consulting available resources in virtual databases, the title and abstract of each study were read by two eligibility reviewers who were not blinded to the authors and journals. The reviewers searched independently, on the same day and at the same time.

Studies without abstracts but whose titles met the objectives of the scoping review were analyzed by reading the full text. A third reviewer resolved disagreements regarding study selection.

Data analysis

After the initial analysis, the selected articles were read in full for a more selective analysis, and those that met the study objectives were included to allow qualitative data extraction. The references from the final collection obtained were also consulted, allowing the addition of two more titles.

The data from the eligible studies were extracted, synthesized, and organized in a table with the following information: study identification (author, year, and location of the study), sample characterization (number of participants, gender, and age), descriptions of the microstomia assessment and the proposed treatment, which are presented qualitatively in the results chapter.

RESULTS

Based on the research project and searches conducted across the selected databases, 263 articles were initially identified, and 24 studies ultimately met the pre-established criteria[11,13-35]. The flowchart of the research process is available in Figure 1.

It was possible to ascertain that, among the therapeutic possibilities suggested in the literature, there were surgical procedures[13-16] (4 studies – 16.67%, such as commissuroplasty and grafts), the application of electromagnetic radiation[17-21] (5 studies – 20.83%, with the use of intense pulsed light, ultraviolet light and fractional carbon dioxide laser) and substances[22-24] (3 studies – 12.5% of the sample, such as botulinum toxin, hyaluronic acid and enzymes); and orofacial myotherapy[11,25-35] (12 studies - 50%, with stretching exercises, isotonic and isometric contraction exercises). Chart 2 summarizes the studies obtained.

Table 1 compares the studies regarding the average gain in mouth opening and the range of improvement. Figure 2 presents the possible treatments for microstomia in systemic sclerosis, explaining the average gain (in millimeters), their possibilities, potential, and limitations.

DISCUSSION

The objective of this study was to characterize, through a scoping review, the treatments for microstomia in individuals with systemic sclerosis, recognizing that mouth opening is necessary for the performance of different oral functions essential for survival, such as chewing and swallowing, in addition to other functions, such as speech and oral hygiene, for example. These functions may be compromised in patients with systemic sclerosis due to limited mouth opening (LMO)[36].

In clinical practice, there are discrepancies in the values adopted for normal mouth opening, ranging from 45 to 60 mm

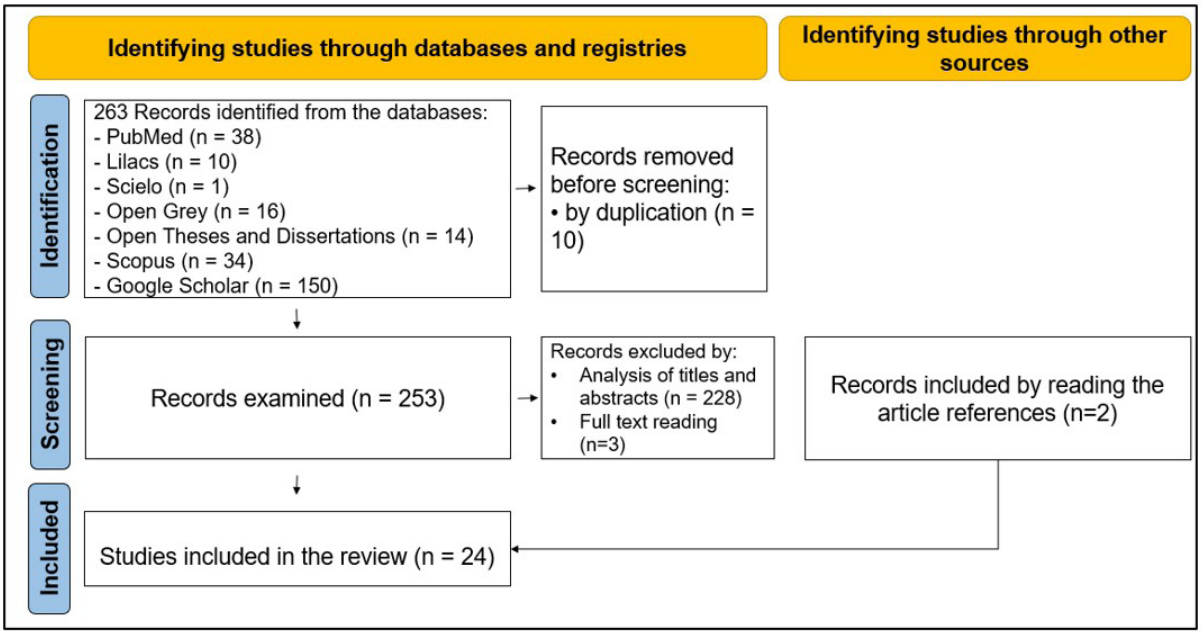

Figure 1. Flowchart of the study selection process based on the PRISMA *Extension for Scoping Reviews* recommendations
Source: Authors

Chart 2. Summary of the 24 studies included by type of treatment for microstomia in systemic sclerosis

Type of Treatment	Author (year), city and country of the research	Sample (n, gender and age)	Description of the assessment of microstomia	Description of the proposed intervention	Main results
Surgical (n=04)	Koymen et al. (2009)[13], Ankara, Türkiye	N=01 (the other 3 cases did not present systemic sclerosis) Gender: Female Age = 31 years old	The assessment was performed by measuring the distance between the maximum labial commissures and the mouth opening, without specifying the method used for these measurements.	Commissuroplasty to release the oral mucosa, removal of fibrotic bands, and use of a semi-dynamic acrylic splint on the first postoperative day, with rotation of the orthodontic expanders every 3-4 days, and maintenance of the splint for approximately 3 months.	Initial MID: 24 mm Final MID: 32 mm Difference of 8 mm The final MID value was maintained 3 months after the commissuroplasty.
	Del Papa et al. (2015)[14], Milan, Italy	N=20 Female gender Average age = 36.5 ± 15	The mouth opening capacity was evaluated by measuring both the MID and the perimeter of the mouth, using the geometric formula for an ellipse: $2\sqrt{a^2 + b^2/2}$, where "a" is the distance between the upper and lower lip and "b" is the distance between the opposite labial commissures, all at maximum mouth opening.	Adipose tissue from the periumbilical or trochanteric region of the abdomen was liposuctioned, centrifuged, and the intermediate layer was injected into six perioral areas (center, sides, and commissures of the upper and lower lips - 2 ml in each region = maximum total of 16 ml/patient). Mouth opening was evaluated by measuring MID before (T0), one month (T1), and three months (T3) after the procedure - reference value for defining microstomia: <55 mm.	T1: average increase of 0.3 mm (between –6.1 and 3 mm) (no statistical difference when compared to T0). T3: average increase was 2.63 mm (between 0.1 and 6 mm), with statistically significant values when compared to T0.
	Blezien et al. (2017)[15], Naples, Italy	N=7 Female gender Age = between 31 and 65 (average: 46.28, SD: 6.37)	The assessment was conducted by asking the patient to open their mouth as wide as possible and measuring the distance between the upper and lower lip with a caliper.	Autologous fat was liposuctioned from the abdomen, hips, anterior thigh, or knees to be injected into the lips concomitantly with platelet-rich plasma, with a maximum of 3 cm^3, in order to avoid overcorrection. A caliper was used to evaluate mouth opening. Re-evaluations were performed six months (T1) and twelve months (T2) after the intervention.	T0: average: 39 mm, SD: 8.2 mm T1: average: 44.6 mm, SD: 5.6 mm T2: average: 45 mm, SD: 5.7 mm Average difference between T0 and T1 = 5.6 mm Average difference between T0 and T2 = 6 mm Side effects were minimal: pain between 3-10 days (11%), ecchymosis (5%), and edema (3%).
	Jeon et al. (2020)[16], London, United Kingdom	N=1 Female gender Age at initial procedure = 42 Age at last procedure = 54	Not cited.	A skin graft from the abdomen was inserted into the mucosa of the lower lip; silicone was injected into the mental muscle, and autologous fat grafting using adipose tissue removed from the abdomen was inserted into the lips, nasolabial folds, cheeks, and chin. These procedures were performed 14 times over 12 years.	There was an approximate increase in mouth opening of 5 mm.

Subtitle: BTX-A = Botulinum toxin Type A; IPL = intense pulsed light; MID = Maximum interincisal distance; SD = Standard deviation; SG = Study group; SSc = Systemic sclerosis; mm = Millimeters, md = mean; MHISS = *Mouth Handicap in Systemic Sclerosis Scale*; N = number of cases; T0 = Initial assessment; T1/2/3/4/6 = Subsequent assessment (depending on the time stipulated in the research); TMJ = Temporomandibular joint; UVA = Ultraviolet A

Chart 2. Continued...

Type of Treatment	Author (year), city and country of the research	Sample (n, gender and age)	Description of the assessment of microstomia	Description of the proposed intervention	Main results
By electromagnetic radiation (n=05)	Tewari et al. (2011)[17], London, United Kingdom	N=01 Female gender Age = 45	Mouth opening was assessed based on the patient's complaints, clinical observation (difficulties opening the mouth and speaking), and measurement of the interdental distance (the method used for this measurement was not specified).	Phototherapy with ultraviolet A1 radiation – UVA1 (340-400 nm) at a dosage of 50 J/cm2 over the entire skin surface (including the perioral area), with applications 2 to 3 times a week, for a total of 40 applications. The MID was evaluated at the beginning (T0) of the therapy and at the fortieth application (T1).	T0: 40 mm T1: 50 mm Difference: 10 mm After 10 sessions, a reduction in skin induration is observed in the perioral region. After 21 sessions, improvement in speech articulation and a reduction of wrinkles around the mouth. After 40 sessions: improvement in MID.
	Comstedt et al. (2012)[18], Malmö, Sweden	N = 4 Female gender Age = between 37 and 61 years old. (average: 42,25, SP 11,84)	Mouth opening was measured in millimeters by determining the distance between the upper and lower incisal edges using a caliper. Values below 50 mm were considered indicative of reduced mouth opening, and the degree of severity was assessed.	Treatment with IPL with the following characteristics: wavelength between 530-570 nm, energy between 11-14 J/cm^2, pulse duration between 10-14 ms. Application areas: perioral region, cheeks, and zygomatic arch. Three to five applications are recommended, with a 4-week interval. Reference values for defining microstomia - mild: between 41-50 mm; moderate between 31-40 mm, and severe ≤ 30 mm (source: Naylor et al., 1984[25]). The maximum mouth opening (MID) was measured at the beginning of therapy (T0) and at the end (T1).	**T0** Case 1: 30 mm Case 2: 26 mm Case 3: 36 mm Case 4: 42 mm Initial average: 33.5 mm, SD: 7 mm **T1** Case 1: 33 mm Case 2: 26 mm Case 3: 39 mm Case 4: 48 mm Final average: 36.5 mm, SD: 9.33 mm.Difference: 3.1 mm. There was a decrease in previous complaints (difficulties with brushing teeth, chewing, and speaking). The ultrasound examination did not show differences before and after treatment in the three patients who underwent the examination. Side effects reported: moderate transient erythema and edema. No scars or pigmentary disorders occurred.
	Comstedt et al. (2017)[19], Lund, Sweden	N=15 Female gender Age = between 34 and 76 years (average: 52.1). Type of SSc: diffuse (5 patients) and limited (10 patients). Duration of the disease: between 3 and 45 years (average 15.6, SD 12.93).	Mouth opening was measured in millimeters using the interincisal distance with the use of a caliper. Edentulous patients were evaluated using the distance between the lips at maximum mouth opening as a reference.	IPL treatment with the following characteristics: wavelength 530-750 nm (PR) or between 550-950 nm (VL), energy between 7.8 - 16 J/cm^2. Application areas: perioral region, lower part of the cheeks, pre-auricular area (including TMJ), eight sessions with an interval of 3-4 weeks. Reference values for defining microstomia - mild: between 41-50 mm; moderate between 31-40 mm, and severe ≤ 30 mm (source: Naylor et al., 1984[25]). MID assessments were performed before laser application (T0), after seven applications (T1), after three months of applications (T3), and after six months (T6).	T0: between 27 and 46mm, average: 35.5 mm T1: between 28 and 49mm, average: 38.66mm T3: between 28 and 49mm, average: 39.08mm T6: between 27 and 49mm, average: 37.08mm Average gain: 4.18 mm, with a statistically significant difference; however, there were no significant differences in the MID between the beginning and the end of the treatment. Other improvements reported: in facial mimicry and lip closure (assisting in the control of food and saliva in the mouth).

Subtitle: BTX-A = Botulinum toxin Type A; IPL = intense pulsed light; MID = Maximum interincisal distance; SD = Standard deviation; SG = Study group; SSc = Systemic sclerosis; mm = Millimeters, md = mean; MHISS = *Mouth Handicap in Systemic Sclerosis Scale*; N = number of cases; T0 = Initial assessment; T1/2/3/4/6 = Subsequent assessment (depending on the time stipulated in the research); TMJ = Temporomandibular joint; UVA = Ultraviolet A

Chart 2. Continued...

Type of Treatment	Author (year), city and country of the research	Sample (n, gender and age)	Description of the assessment of microstomia	Description of the proposed intervention	Main results
	Bhat et al. (2022)[20], Srinagar, India	N=15 Female gender Average age = 52.8 years (ages between 40 and 65 years)	The assessment of mouth opening was performed by measuring the MID with the aid of a ruler and by using the self-administered Mouth Handicap in Systemic Sclerosis questionnaire.	Treatment with a fractional CO_2 laser, with 600W of power and a wavelength of 10,600 nm, was performed in the perioral area under local anesthesia, with a gauze soaked in saline solution in the mouth to prevent accidental burns. A fractional CO_2 laser was used in mobile mode with an F100 handpiece. The resulting spot density = 81–100. The fluence used was 8 mJ/cm², increased by 1–2 mJ/cm² in each subsequent session. Patients received two to three applications, with each application performed without overlapping the spot. Number of sessions = 6, with a four-week interval between each session. Patients were evaluated at the beginning of the study (T0), after three sessions (T1), six sessions (T2), and 3 months after the last session (T3). The evaluation was performed by measuring the interincisal distance with a ruler and applying the Mouth Handicap in Systemic Sclerosis (MHISS) scale at the four moments investigated.	T0: 25.6 ± 4.34 mm T1: 29.5 ± 4.79 mm T2: 35.4 ± 5.78 mm T3: 36.3 ± 6.41 Average gain: 10.7 (average SD: 5.33). There was an improvement in the performance of activities performed by the mouth according to the MHISS scale, decreasing from 24.7 points (average) at T0 to 11.5 (average) at T3. Some adverse effects were reported, including erythema, burning, and stinging sensations; however, these were mild and transient.
	Salimi et al. (2024)[21], Kermanshah, Iran	N=33 Female gender Average age = 47.46 years (SP = 7.11)	The interincisal distance measurement was used to assess the maximum mouth opening capacity before and after treatment with a CO_2 laser. The instrument used for this measurement was not mentioned.	The fractional CO_2 laser (Edge One model, manufactured by Jeisys Company in South Korea) with a power of 30 watts and a wavelength of 10,600 nm was applied to all patients in the perioral region. To prevent accidental burns, a gauze was placed between the teeth and lips. The density of emitted points was 301 (corresponding to 289 active points). The fluence used was 6.9 mJ/cm², and the pulse energy was 25 mJ. At the end of the application, 25% zinc oxide ointment was applied, and the patient was instructed to reapply it three times a day until complete healing was achieved. There were four sessions with an interval of 4 weeks between applications. The MID assessment was performed at the beginning of treatment (T0) and one month after the first application (T1), one month after the second application (T2), and six months after the first application (T3). The MHISS scale was applied at T0 and T4.	T0: average of 48.11 mm T1: average of 50.17 mm T3: average of 50.70 mm Gain of 2.59 mm. There was no statistically significant difference between T0 and T3; however, according to the authors, a decrease in perioral wrinkles was observed. According to the MHISS scale, there was a 7.0-point reduction between T0 and T3, with participants reporting improvements of 60.65% in mouth function.

Subtitle: BTX-A = Botulinum toxin Type A; IPL = intense pulsed light; MID = Maximum interincisal distance; SD = Standard deviation; SG = Study group; SSc = Systemic sclerosis; mm = Millimeters, md = mean; MHISS = *Mouth Handicap in Systemic Sclerosis Scale*; N = number of cases; T0 = Initial assessment; T1/2/3/4/6 = Subsequent assessment (depending on the time stipulated in the research); TMJ = Temporomandibular joint; UVA = Ultraviolet A

Chart 2. Continued...

Type of Treatment	Author (year), city and country of the research	Sample (n, gender and age)	Description of the assessment of microstomia	Description of the proposed intervention	Main results
With the application of substances (n=03)	Hoverson et al. (2018)[22], Maryland, USA	N=5 4 females 1 male Ages = between 31 and 64	Not cited.	Treatment with botulinum toxin A (BTX-A) in the perioral region. BTX-A was applied to the skin covering the orbicularis oris muscle – between 4 and 8 injection sites (average: 6.4 ± 2.19). Dosage: 20 units. Duration of treatment: between 3-27 months (average: 11 ± 9.57 months). Number of treatments: between 1-16 (average: 4.8 ± 6.5).	Initial mouth opening: between 25 mm and 35 mm (mean: 30 ± 5 mm). Mouth opening after treatment: between 40 and 45 mm (mean: 40.4 ± 6.2 mm). Difference: between 5 and 20 mm (mean: 10.4 ± 6.8 mm).
	Pirrello et al. (2019)[23], Palermo, Italy	N =10 Female gender Age: between 18 and 70	With the aid of a digital caliper, the maximum mouth opening was measured in two ways: 1) By the distance from the red border of the upper lip to the red border of the lower lip. 2) By the distance between the upper and lower incisors. The instrument used for this purpose was not mentioned.	Injection of hyaluronic acid (2 ml) combined with platelet-rich plasma (2 ml) in the temporal, zygomatic, philtrum, lip, and mental regions, with an interval of 15-20 days between applications. Total number of applications for each patient: 3. Initial measurements (T0) were taken using a digital caliper, and longitudinal follow-up was performed with four evaluations (T1-T4). The first three evaluations (T1, T2, and T3) were conducted between 1 and 3 months after the applications, and the last evaluation (T4) was performed 24 months later.	T0: 27.05 ± 3.75 mm T1: 30.65 ± 3.82 mm T2: 30.41 ± 3.27 mm T3: 29.03 ± 3.33 mm T4: 28.14 ± 3.72 mm Average difference (T4-T0): 1.09 mm
	Min et al. (2023)[24], Boston, Massachusetts, USA	N=4 (2 with limited SSc, 1 with diffuse SSc) Female gender Average age = 52.3 years (between 43 and 61 years)	Mouth opening was measured vertically, from the upper to the lower edge of the vermilion border of the lips (without mention of the instrument used), and by the score obtained on the self-administered MHSS questionnaire.	Hyaluronic acid (200 units) diluted in saline solution (6 ml) was injected subcutaneously in aliquots approximately 1 cm apart, in two rows around the lip mucosa. Local anesthesia was applied beforehand. Each patient received a total of 2 to 7 injections, with a monthly interval between applications (treatment time: between 3 months (T3) and 5 months (T5), depending on the individual patient's response). The MHISS scale was applied at all three evaluation moments.	T0 = average of 48.0 T3 = average of 53.0 mm* T5 = 54.0 ± 8.5 mm* Average gain of 9.0 mm according to the authors. *The authors did not report the standard deviation. The results of oral performance in the ES showed a decrease in scores, that is, qualitative improvements in 61.9%.

Subtitle: BTX-A = Botulinum toxin Type A; IPL = intense pulsed light; MID = Maximum interincisal distance; SD = Standard deviation; SG = Study group; SSc = Systemic sclerosis; mm = Millimeters, md = mean; MHISS = *Mouth Handicap in Systemic Sclerosis Scale*; N = number of cases; T0 = Initial assessment; T1/2/3/4/6 = Subsequent assessment (depending on the time stipulated in the research); TMJ = Temporomandibular joint; UVA = Ultraviolet A

Chart 2. Continued...

Type of Treatment	Author (year), city and country of the research	Sample (n, gender and age)	Description of the assessment of microstomia	Description of the proposed intervention	Main results
Orofacial Myotherapy (n=12)	Naylor et al. (1984)[25], Boston, Massachusetts USA	N=9 (5 from the experimental group – EG and 4 from the control group – CG) Without mentioning the ages and gender of the participants.	The assessment of mouth opening was performed by measuring the MID, using the following reference parameters for the classification of microstomia: - Mild (Class I): between 41-50 mm; - Moderate (Class II): between 31-40 mm; - Severe (Class III): ≤ 30 mm. Another associated parameter was the patients' complaints, indicating limitations in stomatognathic functions. They did not mention whether they used a caliper, ruler, or other instrument.	Isotonic and isometric exercises were performed for six months, consisting of three sets of five stretches. Exercises for the control group: mandibular movements (maximum opening with and without resistance and mandibular lateralization), filling the cheeks with air, pursing the lips, and exaggerated smiling. Exercises for the experimental group: Stretching of the cheek muscles was achieved by placing the thumb on the buccal mucosa, thereby stretching the aforementioned muscles. The mouth was kept open for a few minutes (the duration increased with the patient's progress in subsequent sessions) with the aid of a set of spatulas introduced into the occlusal surfaces of the premolars and molars. There was a muscle rest between each exercise. Therapy time: 3 months (12 weeks).	Initial assessment (T0), at the third month (T=1), and at the sixth month of therapy (T=2) of maximum mouth opening for the SG group: T0 = mean of 33.6 mm ± 6.69 T1 = mean of 39.2 mm ± 7.05 T2 = mean of 36.75 mm ± 7.89 Mean difference of 5.6 mm (variation between 3 and 8 mm) ± 7.21.
	Pizzo et al. (2003)[26], Palermo, Italy	Of 35 patients, 10 were selected (all female). Age = between 35 and 69 years (average: 56.8; SD: 11.19)	Maximum mouth opening was measured by the MID (without mentioning the instrument used). In edentulous patients, the measurement was taken as the distance between the closest points of the two vermilion borders of the upper and lower lips in the sagittal plane. The classification of Naylor et al. (1984)[25] was used to grade the microstomia.	Patients with severe microstomia (dentulous and edentulous) were included. Treatment was performed in front of a mirror with isokinetic exercises for mouth opening (with the help of the patient's/therapist's thumbs or a piece of wood), keeping the mouth open for some time. The exercises were performed for 15 minutes (twice a day) over a period of 18 weeks, and it was suggested that they be performed permanently, since systemic sclerosis is a chronic and progressive disease. T1 was considered the time of the initial assessment, and T2, the final assessment.	T1: Mean mouth opening: 26 ± 1.76 mm T2: Mean mouth opening: 36.7 ± 2 mm Mean difference: 10.7 ± 2.06 mm

Subtitle: BTX-A = Botulinum toxin Type A; IPL = intense pulsed light; MID = Maximum interincisal distance; SD = Standard deviation; SG = Study group; SSc = Systemic sclerosis; mm = Millimeters, md = mean; MHISS = *Mouth Handicap in Systemic Sclerosis Scale*; N = number of cases; T0 = Initial assessment; T1/2/3/4/6 = Subsequent assessment (depending on the time stipulated in the research); TMJ = Temporomandibular joint; UVA = Ultraviolet A

Chart 2. Continued...

Type of Treatment	Author (year), city and country of the research	Sample (n, gender and age)	Description of the assessment of microstomia	Description of the proposed intervention	Main results
	Maddali Bongi et al. (2009)[27], Florence, Italy	N=20 Female gender =13 Average age = 57.1; SP:15.0	Mouth opening was assessed by measuring the distance between the right upper and lower incisal edges (average of two consecutive measurements). The authors did not mention the instrument used for the measurements.	This 18-week global program offered patients hand exercises (1 hour/session, twice a week), hydrokinesiotherapy (1 hour/session, once a week), and orofacial exercises (1 hour/session, twice a week). For restricted mouth opening, the Kabat method was introduced (stretching maneuvers, movement induction, and muscle resistance exercises for lip protrusion and retraction, upper lip lowering and raising, and contraction of the corrugator supercilii muscle), connective tissue massage of the neck and clavicular region, and kinesiotherapy (mandibular opening and lateralization). MID (maximum interincisal distance) was assessed at baseline (T0), at the ninth and final session (T1), and 9 weeks after discharge (T2).	T0 – MID mean: 34 ± 11 mm T1 – MID mean: 40 ± 12 mm T2 – MID mean: 48 ± 14 mm Difference mean $_{T0\text{-}T2}$: 14 mm ± 12 mm
Orofacial Myotherapy (n=12)	Maddali Bongi et al. (2011)[28], Florence, Italy	N=40 Female gender =34 Average age = 57.28 ± 11.33	Mouth opening was assessed by measuring the distance between the upper and lower right incisal edges (average of two consecutive measurements), without mentioning the instrument used for this purpose.	reatment consisted of 9 weeks of connective tissue massage with manual stretching techniques of the neck and clavicle region for 10 minutes, followed by Kabat technique exercises (stretching, resistance, and proprioceptive facilitation techniques on the orbicularis oris, zygomatic, levator labii superioris, nasal, buccinator, frontal, and corrugator muscles, associated with verbal commands) for 15 minutes, and isotonic contraction exercises for the temporomandibular joint (passive, assisted, and active mandibular opening and lateralization exercises) for 15 minutes, and in the final 20 minutes, relaxation exercises. Patients were instructed to perform maximum mouth opening, lip protrusion, and eyebrow elevation exercises at home (for 18 weeks). The sessions took place twice a week, each lasting one hour. MID assessments were performed at the following time points: T1 = baseline, T2 = end of treatment, and T3 = 9 weeks after the end of the sessions.	T1: Initial MID mean: 38 ± 10.6 mm. T2: MID mean: 42.8 ± 9.9 mm. T3: MID mean: 45.8 ± 11.6 mm Difference $_{T1\text{-}T3}$: 7.8 mm ± 10.7 mm

Subtitle: BTX-A = Botulinum toxin Type A; IPL = intense pulsed light; MID = Maximum interincisal distance; SD = Standard deviation; SG = Study group; SSc = Systemic sclerosis; mm = Millimeters, md = mean; MHISS = *Mouth Handicap in Systemic Sclerosis Scale*; N = number of cases; T0 = Initial assessment; T1/2/3/4/6 = Subsequent assessment (depending on the time stipulated in the research); TMJ = Temporomandibular joint; UVA = Ultraviolet A

Chart 2. Continued...

Type of Treatment	Author (year), city and country of the research	Sample (n, gender and age)	Description of the assessment of microstomia	Description of the proposed intervention	Main results
	Schouffoer et al. (2011)[29], Atlanta, USA	N=53 (Of these, 15 had systemic sclerosis) The authors did not specify how many of those with systemic sclerosis were female (most of the patients in the experimental group – 67.9% – were female). Age of patients with systemic sclerosis: between 18 and 75 (average age of the intervention group: 53.9 ± 10.8).	Maximum mouth opening was measured using a digital caliper by determining the MID, with studies by Naylor et al. (1984)[25] and Maddali Bongi et al. (2009)[27] serving as references for microstomia.	The patients participated in a multidisciplinary intervention program (general exercises, specific exercises for the hand and mouth, as well as receiving educational sessions). To increase mouth opening, static stretches (maintaining mouth opening for 60 seconds) and dynamic stretches (a series of 5 maximum mouth opening movements – 3 sequences) were proposed – both with the aid of the Therabite®. The activities were conducted over 12 weeks. Patients were instructed to repeat the exercises at home, with the support of a diary (6 days a week). The MID was performed with the aid of a digital caliper.	Initial MID mean: 36.5 ± 9.3 mm. Final MID mean: 37.9 mm (both after 12 weeks and after 24 weeks). Mean difference: 1.4 mm
	Yuen et al. (2012)[30], Charleston, USA	N=48 Female gender=38. Average age = 50.7 ± 13.	Mouth opening was measured (three consecutive times, with a five-second interval between each measurement) using a small metal ruler, graduated in mm, positioned between the upper and lower incisal edges of the right central incisors, with participants asked to open their mouths as wide as possible. If the right central incisors were absent, the left central incisors, right lateral incisors, or left lateral incisors were substituted in that order.	Home exercises that incorporate oral hygiene techniques (using an electric toothbrush) were combined with stretching techniques for the suprahyoid muscles, followed by a passive maneuver to maintain mouth opening for 15-20 seconds. To increase mouth opening, a piece of wood (dimensions 2 cm × 1.5 cm × 9.5 cm) was introduced until it reached the posterior teeth of one dental arch, and it was kept in that position for 15-20 seconds. The procedure should be repeated three times, with a 10-second interval between each exercise. The results should be recorded in a diary. Duration of the study: 6 months (24 weeks), including evaluation of the maximum interincisal distance (MID) at T0 (baseline), T1 (after 3 months), and T2 (after 6 months).	T0: MID mean: 30.1 ± 6.7 mm T2: MID mean: 27.4 ± 7.4 mm Mean difference: -2.7 mm Participants did not show improvement with home exercises and demonstrated low adherence to the program (48.9%). The frequency of performing the exercises was considered insufficient, as well as the number of repetitions and the duration of the exercises.

Subtitle: BTX-A = Botulinum toxin Type A; IPL = intense pulsed light; MID = Maximum interincisal distance; SD = Standard deviation; SG = Study group; SSc = Systemic sclerosis; mm = Millimeters, md = mean; MHISS = *Mouth Handicap in Systemic Sclerosis Scale*; N = number of cases; T0 = Initial assessment; T1/2/3/4/6 = Subsequent assessment (depending on the time stipulated in the research); TMJ = Temporomandibular joint; UVA = Ultraviolet A

Chart 2. Continued...

Type of Treatment	Author (year), city and country of the research	Sample (n, gender and age)	Description of the assessment of microstomia	Description of the proposed intervention	Main results
	Baldrighi et al. (2014)[31], Aracaju, Sergipe, Brazil	N=1 Female gender Age= 43	Mouth opening was assessed using a Wersten 6" digital caliper, measuring the maximum interincisal distance in the frontal plane.	Treatment included muscle stretching (scapular, cervical, and facial regions, including the temporalis, masseter, and sternocleidomastoid muscles), isotonic exercises (lip protrusion, retraction, and lateral movement, sequences of tongue protrusion and retraction, as well as maximum elevation and lowering of the tongue, and sequences of mouth opening and closing – 2 to 3 minutes), and isometric exercises (mandibular protrusive movement, maintaining the contraction in the most anterior position possible for 10 seconds), and oral functions encompassing chewing and swallowing. A total of 35 sessions were performed, once a week. The same exercises were performed at home three times a day.	Initial MID: 26.9 mm. Final MID: 36.9 mm. Difference: 10 mm
	Maddali Bongi et al. (2014)[32], Florence, Italy	N=26 Female gender=22 Average age: 59.08, SP:10.31	The authors stated that the measurement was taken in millimeters, but they did not mention how the assessment was carried out or the instrument used for the measurements.	Protocol 1 - Patients performed exercises at home: facial mimicry and exercises involving the masticatory and neck muscles, for 20 minutes (3 times a week). Protocol 2 - Myofunctional exercises of the face and neck, connective tissue massage, Kabat technique for facial muscles, manual intra- and extraoral manipulation techniques of the TMJ, stretching and mobilization of the craniocervical muscles, for one hour/week, for 12 weeks. Evaluations were performed at baseline (T0), at the end of treatment (T1), and 8 weeks after the end of treatment (T2).	Protocol 1 T0 - Initial mouth opening mean: 42.83 ± 9.51 mm T1 - Final mouth opening mean: 44.42 ± 13.83 mm T2 - Final mouth opening mean: 45.08 ± 9.18 mm Mean difference (T0-T2): 3 mm ± 10.84 mm Protocol 2 T0 - Initial mouth opening mean: 44.79 ± 9.17 mm T1 - Final mouth opening mean: 51.57 ± 8.8 mm T2 - Final mouth opening mean: 50.57 ± 9.06 mm Mean difference (T0-T2): 6 mm ± 9.01 mm

Subtitle: BTX-A = Botulinum toxin Type A; IPL = intense pulsed light; MID = Maximum interincisal distance; SD = Standard deviation; SG = Study group; SSc = Systemic sclerosis; mm = Millimeters, md = mean; MHISS = *Mouth Handicap in Systemic Sclerosis Scale*; N = number of cases; T0 = Initial assessment; T1/2/3/4/6 = Subsequent assessment (depending on the time stipulated in the research); TMJ = Temporomandibular joint; UVA = Ultraviolet A

Chart 2. Continued...

Type of Treatment	Author (year), city and country of the research	Sample (n, gender and age)	Description of the assessment of microstomia	Description of the proposed intervention	Main results
	Almeida et al. (2016)[11], Aracaju, Sergipe, Brazil	N=5 Female gender =4 Age = between 24 and 60 (average:44.6, SP: 14.28)	To assess mouth opening, a Western 6" digital caliper with a precision of 0.01 mm was used, by measuring the MID before and after the intervention, in the frontal view.	The treatment consisted of gliding and kneading maneuvers to relax and stretch the muscles of the scapular, cervical, and facial regions, as well as specific muscles (temporalis, masseter, and sternocleidomastoid), followed by isotonic exercises (mobility of the lips, tongue, and cheeks, including facial mimicry exercises), isometric exercises (for the suprahyoid muscles), and oral functions (chewing and swallowing – with solid and liquid foods), performed once a week in 50-minute sessions for 18 months (equivalent to 36 sessions). The assessment of the MID was performed at T1 (initial assessment) and T2 (end of therapy).	T0: Initial MID between 26.9 and 40 mm, average: 34.18 ± 5.48 mm T1: Final MID between 36.5 and 54.2 mm, average: 43.44 ± 7.36 mm Differences between 5.3 and 14.2 mm, average: 9.26 ± 3.51

Subtitle: BTX-A = Botulinum toxin Type A; IPL = intense pulsed light; MID = Maximum interincisal distance; SD = Standard deviation; SG = Study group; SSc = Systemic sclerosis; mm = Millimeters, md = mean; MHISS = *Mouth Handicap in Systemic Sclerosis Scale*; N = number of cases; T0 = Initial assessment; T1/2/3/4/6 = Subsequent assessment (depending on the time stipulated in the research); TMJ = Temporomandibular joint; UVA = Ultraviolet A

Chart 2. Continued...

Type of Treatment	Author (year), city and country of the research	Sample (n, gender and age)	Description of the assessment of microstomia	Description of the proposed intervention	Main results
	Rannou et al. (2017)[33], Paris, France	N=218 Female gender =181 Average age= 52.7 (SP: 14.8)	Microstomia was evaluated using the MID, in millimeters, with the use of a "rigid decimal scale", according to the authors.	A physiotherapy and occupational therapy program associated with home-based intervention was implemented. Patients were randomly assigned to two groups (control and experimental). The objectives of the program were to increase the range of motion of affected joints, increase muscle strength and aerobic capacity, minimize oral microstomia, skin contractures, limitations in activities, and restrictions in participation. The exercises were tailored to the specific needs and difficulties of the patients. For microstomia, the following exercises were performed: passive mouth opening in the supine position (15 minutes per session); with the mouth wide open and in front of a mirror (10 repetitions): 1) emitting the vowel /a/ for 5 seconds; 2) exhaling air in front of the mirror to fog it up. Two other exercises were proposed in front of the mirror: emitting the vowel /i/ for 5 seconds (10 repetitions) and inserting the index finger into the buccal mucosa of the cheek, pulling it outwards (5 minutes per cheek). Three sessions/week were performed, with a daily duration of 3 hours, for 4 weeks. Home exercises were provided to the patients, with instructions to perform them for 30 minutes daily, a maximum of 8 exercises per session, and telephone support was offered. Four assessments were performed: T0 (baseline), T1 (at the end of one month), T6 (after 6 months), and T12 (after one year).	Mean at T0: 35.36 ± 8.41 mm Mean at T1: 37.48 ± 8.17 mm Mean at T6: 37.38 ± 8.45 mm Mean at T12: 37.91 ± 8.06 mm Mean differences between T0-T1: 2.12 ± 8.29 mm, between T0-T6: 2.02 ± 8.43 mm and between T0-T12: 2.55 ± 8.32 mm

Subtitle: BTX-A = Botulinum toxin Type A; IPL = intense pulsed light; MID = Maximum interincisal distance; SD = Standard deviation; SG = Study group; SSc = Systemic sclerosis; mm = Millimeters, md = mean; MHISS = *Mouth Handicap in Systemic Sclerosis Scale*; N = number of cases; T0 = Initial assessment; T1/2/3/4/6 = Subsequent assessment (depending on the time stipulated in the research); TMJ = Temporomandibular joint; UVA = Ultraviolet A

Chart 2. Continued...

Type of Treatment	Author (year), city and country of the research	Sample (n, gender and age)	Description of the assessment of microstomia	Description of the proposed intervention	Main results
	Uras et al. (2019)[34], Rome, Italy	N=63 Female gender Average age = 54.6, SP: 15.8	Mouth opening was measured with a plastic caliper by a professional blinded to the randomization status. Two consecutive measurements of the MID were performed. In addition, the patient had a complaint and limitation of mouth opening, and the Italian version of the standardized self-administered questionnaire MHISS was used.	The experimental group followed protocols 1 and 2, while the control group followed only protocol 2. Protocol 1: In-person intervention with prior application of facial moisturizer and cocoa butter to the lips, followed by lip stretching exercises. For mouth opening, spatulas are placed between the premolars and molars, with a gradual increase in the number of spatulas; and for tongue mobility: elevation, protrusion, and lateralization, performed in front of a mirror. Protocol 2: Patients were instructed using a pamphlet and a video recording demonstrating the exercises to be performed at home. In both protocols, patients were instructed to stop the activity if they experienced fatigue and/or pain. Period of 12 months (58 weeks), 25 minutes per day. MID measured with a plastic caliper.	Initial MID mean: 36.9 ± 6.5 mm Final MID mean: 40.0 ± 7.6 mm Mean difference: 1.8 mm (range between 0.3 and 3.9 mm) ± 7.05 mm
	Melchiorre et al. (2023)[35], Florence, Italy	N=26 Female gender=22 Male gender = 4 Average age = ± 59.08, SD 10.31	With the aid of the Therabite® device, the maximum mouth opening was assessed by averaging two measurements of the interincisal distance and adding the vertical overbite of the incisors.	Protocol 1: Home exercises (20 minutes per day, 3 times a week) for TMJ, including facial mimicry, masticatory muscles, and cervical spine (without detailing the exercises themselves). Protocol 2: Home exercises (as in Protocol 1) and a combined procedure (once a week and 45 minutes per session) including connective tissue massage of the face and neck (short, firm gliding movements) and Kabat technique (stretching exercises, counter-resistance, and proprioceptive facilitation techniques on the orbicularis oris, zygomatic, levator labii superioris, nasal, buccinator, frontal, and corrugator muscles, associated with verbal commands). Each protocol lasted a total of 20 weeks (approximately 5 months), consisting of 12 weeks (3 months) of treatment and 8 weeks (2 months) of follow-up. Patients were evaluated at the time of inclusion (T0), after 12 weeks of treatment (T1), and after 8 weeks of follow-up (T2), and the MHISS scale was applied.	Protocol 1 T0 - Mouth opening mm - 39.10 ± 4.58 T1 - Mouth opening mm - 44.90 ± 5.43 T2 - Mouth opening mm - 44.60 ± 5.04 Average difference (T0-T2): 5.5 ± 4.81mm Protocol 2 T0 - Mouth opening mm - 46.00 ± 4.12 T1 - Mouth opening mm - 51.00 ± 3.19 T2 - Mouth opening mm - 51.60 ± 3.50 Average difference (T0-T2): 5.6 ± 3.81mm

Subtitle: BTX-A = Botulinum toxin Type A; IPL = intense pulsed light; MID = Maximum interincisal distance; SD = Standard deviation; SG = Study group; SSc = Systemic sclerosis; mm = Millimeters, md = mean; MHISS = *Mouth Handicap in Systemic Sclerosis Scale*; N = number of cases; T0 = Initial assessment; T1/2/3/4/6 = Subsequent assessment (depending on the time stipulated in the research); TMJ = Temporomandibular joint; UVA = Ultraviolet A

Table 1. Comparison between studies regarding the average increase in mouth opening and range of improvement

Type of Treatment	Number of studies	Average mouth opening gain (mm)	Improvement range
Surgical	4[13,16]	5,4 mm	From 0,3 to 8 mm
Electromagnetic radiation	5[17-21]	3,64 mm	From 2,6 to 10,7 mm
Application of substances	3[22-24]	6,83 mm	From 1,1 to 10,4 mm
Orofacial myotherapy	12[11,25-35]	4,06 mm	From -2,7 to 14 mm

Subtitle: mm = Millimeters
Source: Authors

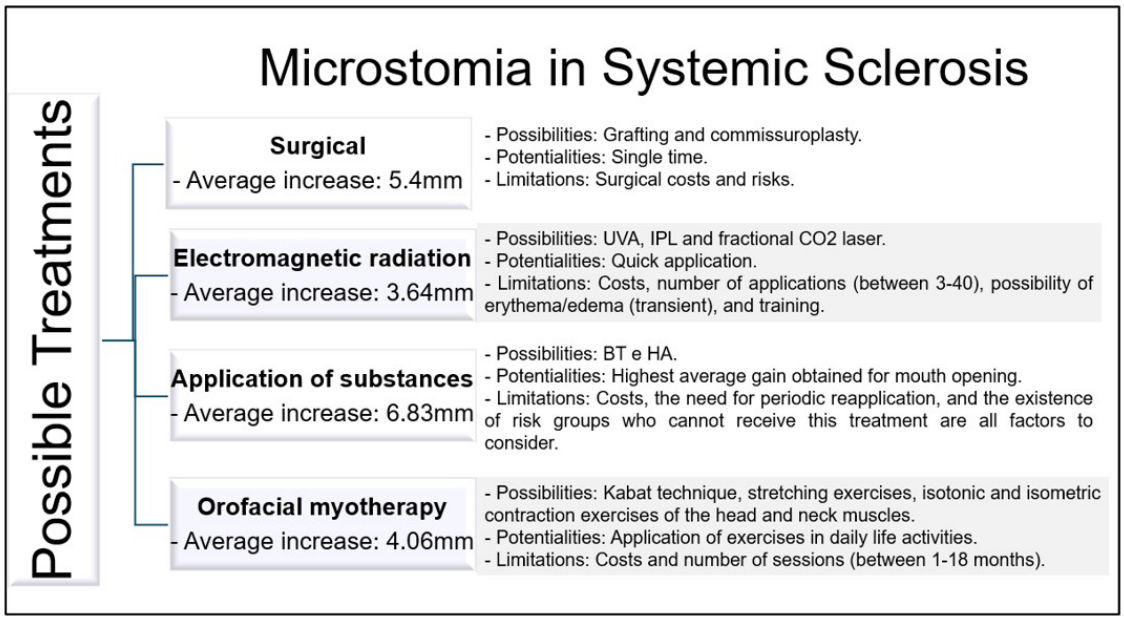

Figure 2. Diagram outlining possible treatments for microstomia in systemic sclerosis, specifying the average gain (in millimeters), their possibilities, potential, and limitations
Note: "Possibilities" refer to the therapeutic alternatives available in each modality; "potentialities" correspond to the expected clinical effects (such as increased mouth opening or treatment time); "limitations" indicate the restrictions or barriers in the clinical application of each intervention.
Subtitle: HA = hyaluronic acid; mm = millimeters; CO2 = carbon dioxide; IPL = intense pulsed light; BT = botulinum toxin; UVA = ultraviolet radiation
Source: Authors

for some authors[37], whereas others[14] consider measurements below 55 mm in adults to represent limited mouth opening (LMO). Researchers[25] consider microstomia present when values are below 51 mm, classifying it as mild or Class I (41-50 mm), moderate or Class II (31-40 mm), or severe or Class III (<30 mm). Therefore, discrepancies in reference values can affect the inclusion (or exclusion) of microstomia as a manifestation in patients with systemic sclerosis (SSc).

Different hypotheses are listed for this occurrence, such as alterations in the connective tissue, the possibility of bone resorption, stiffness in the orofacial muscles, and the presence of fibrosis in the synovial fluid of the temporomandibular joint, most likely due to increased levels of autoantibodies, pro-fibrotic cytokines, and extracellular matrix remodeling enzymes, such as matrix metalloproteinase 9 (MMP-9), chemokine (such as CXC4), and interleukin (IL-6)[38]. Certainly, LOM has negative impacts on the quality of life and health of patients with SS, making it necessary for healthcare professionals who care for them to be aware of techniques and strategies for its minimization, since the disease is progressive.

Among the possible treatments for limited mouth opening (LMO) in patients with systemic sclerosis (SSc), surgical procedures[13-16], the application of electromagnetic radiation[17-21] and substances[22-24], and orofacial myotherapy[11, 25-35] have been described. The four studies[13-16] that reported surgery for patients with SSc and microstomia were international: two Italian, one English, and one Turkish. The surgery consisted of removing skin tissue from the abdomen for grafting in the perioral region[14] or lips[13,15,16]. The results of the four studies indicated an average gain in mouth opening of 5.4 mm. The limitations of surgical procedures lie in their costs and the risks they entail.

Electromagnetic radiation can be used as a therapeutic resource through intense pulsed light (IPL) therapy, radio waves, microwaves, infrared radiation (near, medium, and far), ultraviolet, visible light, X-rays, and gamma rays[39], each presenting specific therapeutic applications. It can be applied at different times and emitted continuously or pulsed, with varying energy densities (measured in joules – J) and power or irradiance (measured in mW/cm^2). Electromagnetic radiation was applied in five studies: 1 Italian[17], 1 Indian[20], 1 Iranian[21], and 2 Swedish[18,19]. The number of sessions varies between three and 40 (average: 17.33).

Ultraviolet (UV) radiation can be applied in three distinct ranges: A (between 320 and 400 nm), B (between 280 and 320 nm), and C (between 100 and 280 nm)[40]. In the sample of this scoping review, one study[17] used UVA 1 (between 340 and 400 nm, since UVA 2 has a light wavelength between 320 and 340 nm). Due to its longer wavelength, UVA1 radiation has a greater capacity for skin penetration than UVA2, reaching not only the epidermal structures but also the middle and deep layers of the dermis, with particular emphasis on the vascular components[40]. In the clinical case reported in the literature[17], the increase was 10 mm, from a limitation in mouth opening (starting at 40 mm) to a value within the normal range. However, it should be noted that the maximum interincisal distance (MID) tends to be greater depending on gender (male), weight (heavier people), age (younger people), and height (taller people), and the clinician should take these variables into account to avoid diagnostic errors[41].

Two studies[18,19] used Intense Pulsed Light (IPL) as a therapeutic modality. This type of radiation, according to the literature[42], uses polychromatic and pulsed light to treat various dermatological diseases, acting mainly through selective photothermolysis. As demonstrated in a systematic review[42], IPL shows significant efficacy in the management of different dermatological conditions (such as rosacea, telangiectasias, photodamage, and hyperkeratosis), is safe, and has minimal, transient adverse effects. The average increase in interincisal distance ranged from 3.1 mm[18] to 4.18 mm[19] (average: 3.64 mm), which could be an alternative for the treatment of microstomia in SSc.

The laser, emitting far-infrared radiation, powered by carbon dioxide (CO_2), heats the water present in biological tissues and can be used continuously or in a pulsed/fractionated manner, generally for vaporization, coagulation, and ablation. Among its actions are stimulation of collagen production, increased tissue elasticity, and reduced fibrosis and adhesions[43], which justify its use in patients with microstomia due to systemic sclerosis. Its benefits have been cited in the literature[20,21], although without statistical significance, with an average final gain of 2.59 mm[21] to 10.7 mm[20] (average of the two studies: 6.64 mm), demonstrating improvements in this regard.

It is essential to highlight the use of electromagnetic radiation in Speech Therapy. Speech therapists have the right, provided they are adequately trained, to use photobiomodulation (in this case, low-intensity or low-power light radiation: Low-Level Laser Therapy – LLLT and light-emitting diode: Light Emitting Diode – LED), according to a resolution of the Brazilian Federal Council of Speech Therapy (CFFa) [44]. Therefore, the use of IPL, ultraviolet radiation in the A range (UVA), and CO2 laser is not permitted for this professional category at this time.

Substances (botulinum toxin - BT and hyaluronic acid - HA) were used in three studies[22-24], two American[22,24] and one Italian[23]. Among all the possibilities, this treatment, on average, produced the most significant increase in mouth opening (6.83 mm). However, the drawback is that the effect of botulinum toxin (BT) is temporary, requiring periodic reapplication. The effect of hyaluronic acid, on the other hand, was the most effective, with greater durability.

Botulinum toxin (BT), a substance produced by the bacterium Clostridium botulinum, can control or inhibit neurotransmission by preventing the release of acetylcholine at the presynaptic terminal, resulting in muscle contraction blockage and, consequently, muscle paralysis. The dosage depends on the muscle strength and extent, and it is important to note that repeated applications may not produce the desired effect, as the body may mount an immunological response that prevents the toxic action of the bacterium[45]. Its use in the facial muscles of patients with SSc aims to reduce muscle stiffness, enabling easier mouth opening.

Hyaluronic acid (HA) is a polysaccharide found in the human body. It has been used in dentistry due to its biocompatibility, antioxidant, anti-edematous, bacteriostatic, anti-inflammatory, and tissue-regenerative properties. Despite the numerous advantages highlighted for the treatment of periodontitis, the heterogeneity of studies to date does not allow us to confidently affirm its benefits[46]. When applied to the connective tissue of the face, it provides the skin, among other aspects, with the maintenance of skin's elasticity[47], a desired effect for patients with SSc. However, the authors[47] also clarified that its use is not free of undesirable side effects and is contraindicated in patients with hypersensitivity to streptococci or Gram-positive bacteria, lidocaine, or avian protein. Furthermore, it should not be applied to skin with lesions or inflammation, or in pregnant and breastfeeding women. It is worth noting that its effects are also transient, lasting 11-24 months, depending on the chosen brand, according to the literature[48].

Orofacial myotherapy was proposed by half of the sample in the present study, i.e., by twelve studies[11,25-36], with the largest concentration of studies being Italian[26-28,32,34,35], with six studies, three American[25,29,30], two Brazilian[11,31], and one French[33]. It is the least invasive approach and the one with the most publications on the subject. The gain in mouth opening ranged from -2.7 mm to 14 mm, and the average gain in oromotor rehabilitation was 4.06 mm. However, some of the proposed exercises were either not described in detail or not specific to mouth opening due to combined objectives (e.g., increasing mouth opening and promoting facial mimicry), making it challenging to identify which exercises were effective for this purpose. It should also be noted that in one study, the outcome was worse at the end of treatment due to poor patient adherence[30].

The promotion of passive and/or active mobilization of the temporomandibular joints was cited by all authors who proposed oromotor myotherapy[11,25-35], including evaluation of the mandible with a ruler or caliper (plastic or digital). Altered chewing function may be related to temporomandibular joint disorder and limitations of mandibular movements. Furthermore, the literature[11] justified this limitation by the stiffening of the skin due to collagen deposition in the perioral tissues.

Manipulation and stretching of the muscles of the cranio-oro-cervical complex (such as the orbicularis oris, sternocleidomastoid, and trapezius) were also strategies adopted by the authors[11,25,27,28,30-32,34,35]. Generally, muscle stretching is a preparatory activity for subsequent exercises and can be passive or active, with different execution times[49]. Increased flexibility, both of the muscles involved and of the tendons, ligaments, and muscle fascia, tends to decrease pain sensitivity[50], justifying its use in clinical practice.

Isometric exercises, particularly of the suprahyoid muscles, have been proposed by some researchers[11,27,28,31-34] to increase the strength of orofacial muscles[51], which, among other functions, open the mouth. Combined exercises involving muscle stretching and isometric contractions are engaging because they require a coordinated effort between agonist

muscles (where increased contraction is desired) and antagonist muscles (which maximize muscle relaxation).

Regarding orofacial myofunctional exercises, the literature[52] further corroborates the need for objective instruments to evaluate patients with systemic sclerosis. In this way, quantitative data could help demonstrate the effectiveness of orofacial myofunctional treatment directed at microstomia in patients with SSc.

The number of sessions ranged from 1 month (4 weeks) to 18 months (average of 20.83 weeks) for myofunctional or orofacial therapy/myotherapy performed by the speech therapist. The other procedures, which are not the responsibility of this professional, were obtained in the following average times: substance application, 30 weeks; electromagnetic radiation, 12.6 applications; and surgical time was a single event. Thus, an estimate of the average times for the procedures is available for decision-making by the multidisciplinary or interdisciplinary team, as well as for the patient and/or family.

It is worth noting that new modalities, such as photobiomodulation, have not yet been published by researchers in the field. A clinical report using photobiomodulation (four points on the sublingual glands with 660 nm, 100 mW and 0.8 J/cm^2 at each point; eight points on the parotid glands and six points on the submandibular glands with 808 nm, 100 mW and 0.8 J/cm^2 for eight seconds at each point) was described, aiming to reduce xerostomia in a 7-year-old girl with Sjögren's Syndrome, showing satisfactory results[53]. In the case presented by the authors, in addition to decreased salivary flow and the precarious state of tooth preservation, complaints of LMO and difficulties with chewing and swallowing were also reported. If there had been a speech therapist on the team, other possibilities could have been explored, in addition to an objective description of the results obtained regarding stomatognathic functions.

No studies have proposed combined therapies, that is, the application of electromagnetic radiation with orofacial myotherapy or with substances (BT or HA), for example, to achieve greater gains in mouth opening. Only physiotherapeutic treatments associated with physical activity have been indicated, although their effectiveness was minimal[29], and orofacial myotherapy with home exercises[28-35].

There are controversies in the literature regarding the provision of therapeutic activities at home, as patient adherence is not always guaranteed for the desired success. In this sense, it is recommended that the speech therapist select the most effective exercises and that the patient is both familiar with and comfortable performing them, so that there is a perfect understanding of the therapeutic objectives to be achieved when performing the activities at home. The use of illustrations and instructional videos can also be helpful. Furthermore, the literature[54] suggests that they should be as functional as possible to be feasible within patients' daily lives.

Researchers[55] used a formula to predict the maximum mouth opening of patients with systemic sclerosis, finding that, with the formula, male gender predicted an increase (around 6 mm), while some variables were associated with a decrease, such as the presence of interstitial lung disease (approximately 3 mm); for every 10 mm increase in the modified Rodnan skin score (mRSS –3.7 mm less) and the distance from the fingertip to the palm greater than 0 mm (around 5 mm). These results highlight the need to assess maximum mouth opening in patients with systemic sclerosis and to provide early intervention.

Furthermore, knowing the treatment options for microstomia allows the specialist managing the clinical case to make the best decision for their patient. Ideally, multidisciplinary teams (rheumatologists, plastic surgeons, dermatologists, speech therapists, physiotherapists, among others) should be formed to determine the best therapeutic plan for each situation; however, as noted in the literature[16], this reality remains distant. In addition, due to certain conditions (lack of adherence to orofacial exercises, lack of specialists on the clinical team, and disease progression), alternatives must be sought to ensure stomatognathic functions are performed as effectively as possible.

Several limitations in this scoping review need to be highlighted, such as the lack of information in most studies regarding the disease (staging, duration, and/or classification), the absence of detailed descriptions of the procedure for measuring mouth opening, small sample sizes, lack of detailed information about the exercises performed and protocols adopted, as well as differences in criteria for normal mouth opening, preventing the generalization of data. The inclusion of case reports was also a limiting factor, underscoring the need for more robust clinical studies in this area.

CONCLUSION

The scope review identified multiple therapeutic strategies for microstomia in patients with systemic sclerosis, including orofacial myofunctional exercises, pharmacological interventions, surgical procedures, and electromagnetic radiation. Despite this diversity, the scientific evidence remains limited and heterogeneous, underscoring the need for robust clinical trials that compare the effectiveness of interventions in this condition.

The findings reinforce the importance of an interdisciplinary, personalized approach that considers each patient's clinical, functional, and socioeconomic conditions.

REFERENCES

1. Sobolewski P, Maślińska M, Wieczorek M, Łagun Z, Malewska A, Roszkiewicz M, et al. Systemic sclerosis – multidisciplinary disease: clinical features and treatment. Reumatologia. 2019;57(4):221-33. https://doi.org/10.5114/reum.2019.87619. PMid:31548749.

2. Makris A, Panagiotopoulos A, Distler O, Sfikakis PP. Systemic sclerosis sine scleroderma: a time of reappraisal. J Rheumatol. 2024;51(11):1060-8. https://doi.org/10.3899/jrheum.2023-1113. PMid:38950948.

3. Cutolo M, Soldano S, Smith V. Pathophysiology of systemic sclerosis: current understanding and new insights. Expert Rev Clin Immunol. 2019;15(7):753-64. https://doi.org/10.1080/1744666X.2019.1614915. PMid:31046487.

4. Luquez-Mindiola A, Atuesta AJ, Gómez-Aldana AJ. Gastrointestinal manifestations of systemic sclerosis: an updated review. World J Clin Cases. 2021;9(22):6201-17. https://doi.org/10.12998/wjcc.v9.i22.6201. PMid:34434988.

5. Smirani R, Truchetet M-E, Poursac N, Naveau A, Schaeverbeke T, Devillard R. Impact of systemic sclerosis oral manifestations on

patients' health-related quality of life: a systematic review. J Oral Pathol Med. 2018;47(9):808-15. https://doi.org/10.1111/jop.12739. PMid:29855076.

6. Burchfield C, Vorrasi J. Maxillofacial implications of scleroderma and systemic sclerosis: a case report and literature review. J Oral Maxillofac Surg. 2019;77(6):1203-8. https://doi.org/10.1016/j.joms.2019.01.027. PMid:30794809.

7. Torquato LC, Maciel CCM, Almeida ND, Oliveira W, Jardini MAN, Melo ABF, et al. Systemic scleroderma: imaging findings of diagnosis and clinical management of temporomandibular joint disorders. Braz Dent Sci. 2023;26(4):e3998. https://doi.org/10.4322/bds.2023.e3998.

8. Almeida MSTM, Fernandes MLM, Moreira TCA. Temporomandibular joint disorder in systemic sclerosis: a case report. OAlib. 2022;9(11):e9434. https://doi.org/10.4236/oalib.1109434.

9. Türk İ, Cüzdan N, Çiftçi V, Arslan D, Ünal İ. Correlations between clinical features and mouth opening in patients with systemic sclerosis. Arch Rheumatol. 2020;35(2):196-204. https://doi.org/10.46497/ArchRheumatol.2020.7434. PMid:32851368.

10. Beaty KL, Gurenlian JR, Rogo EJ. Oral health experiences of the limited scleroderma patient. J Dent Hyg. 2021;95(4):59-69. PMid:34376545.

11. Almeida LF, Lima MC, Macieira JC, César CPHAR, Baldrighi SEZM. Speech therapy in systemic sclerosis: a case report. Rev CEFAC. 2016;18(1):273-85. https://doi.org/10.1590/1982-0216201618117715.

12. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. Ann Intern Med. 2018;169(7):467-73. https://doi.org/10.7326/M18-0850. PMid:30178033.

13. Koymen R, Gulses A, Karacayli U, Aydintug YS. Treatment of microstomia with commissuroplasties and semidynamic acrylic splints. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2009;107(4):503-7. https://doi.org/10.1016/j.tripleo.2008.10.008. PMid:19138538.

14. Del Papa N, Caviggioli F, Sambataro D, Zaccara E, Vinci V, Di Luca G, et al. Autologous fat grafting in the treatment of fibrotic perioral changes in patients with systemic sclerosis. Cell Transplant. 2015;24(1):63-72. https://doi.org/10.3727/096368914X674062. PMid:25606975.

15. Blezien O, D'Andrea F, Nicoletti GF, Ferraro GA. Effects of fat grafting containing stem cells in microstomia and microcheilia derived from systemic sclerosis. Aesthetic Plast Surg. 2017;41(4):839-44. https://doi.org/10.1007/s00266-017-0904-1. PMid:28597066.

16. Jeon FHK, Griffin M, Varghese J, Butler PEM. Oro-facial fibrosis in systemic sclerosis: a reconstructive journey. BMJ Case Rep. 2020;13(10):e236663. https://doi.org/10.1136/bcr-2020-236663. PMid:33040038.

17. Tewari A, Garibaldinos T, Lai-Cheong J, Groves R, Sarkany R, Novakovic LB. Successful treatment of microstomia with UVA1 phototherapy in systemic sclerosis. Photodermatol Photoimmunol Photomed. 2011;27(2):113-4. https://doi.org/10.1111/j.1600-0781.2011.00570.x. PMid:21392116.

18. Comstedt LR, Svensson Å, Troilius A. Improvement of microstomia in scleroderma after intense pulsed light: a case series of four patients. J Cosmet Laser Ther. 2012 Apr;14(2):102-6. https://doi.org/10.3109/14764172.2012.672744. PMid:22401663.

19. Comstedt LR, Svensson Å, Hesselstrand R, Lehti L, Troilius Rubin A. Effects of intense pulsed light in microstomia in patients with systemic sclerosis: a pilot study. J Cosmet Laser Ther. 2017;19(3):143-8. https://doi.org/10.1080/14764172.2016.1262961. PMid:27911118.

20. Bhat YJ, Bashir Y, Latif I, Daing A, Devi R, Shah IH, et al. Efficacy of fractional CO2 laser for improvement of limited mouth opening in systemic sclerosis. J Cutan Aesthet Surg. 2022;15(4):387-93. https://doi.org/10.4103/JCAS.JCAS_29_21. PMid:37035592.

21. Salimi E, Assar S, Salimi A, Mohamadzadeh D. Fractional carbon dioxide laser for treatment of microstomia and rhytids in systemic sclerosis patients. Mediterr J Rheumatol. 2024;35(3):459-63. https://doi.org/10.31138/mjr.101223.fcd. PMid:39463866.

22. Hoverson K, Love T, Lam TK, Marquart JD. A novel treatment for limited mouth opening due to facial fibrosis: a case series. J Am Acad Dermatol. 2018;78(1):190-2. https://doi.org/10.1016/j.jaad.2017.07.006. PMid:29241782.

23. Pirrello R, Verro B, Grasso G, Ruscitti P, Cordova A, Giacomelli R, et al. Hyaluronic acid and platelet-rich plasma, a new therapeutic alternative for scleroderma patients: a prospective open-label study. Arthritis Res Ther. 2019;21(1):286. https://doi.org/10.1186/s13075-019-2062-0. PMid:31836018.

24. Min MS, Goldman N, Mazori DR, Guo LN, Vleugels RA, LaChance AH. Hyaluronidase injections for oral microstomia in systemic sclerosis and mixed connective tissue disease. JAMA Dermatol. 2023;159(12):1393-5. https://doi.org/10.1001/jamadermatol.2023.3893. PMid:37851438.

25. Naylor WP, Douglass CW, Mix E. The nonsurgical treatment of microstomia in scleroderma: a pilot study. Oral Surg Oral Med Oral Pathol. 1984;57(5):508-11. https://doi.org/10.1016/0030-4220(84)90309-8. PMid:6587299.

26. Pizzo G, Scardina GA, Messina P. Effects of a nonsurgical exercise program on the decreased mouth opening in patients with systemic scleroderma. Clin Oral Investig. 2003;7(3):175-8. https://doi.org/10.1007/s00784-003-0216-5. PMid:14513305.

27. Maddali Bongi S, Del Rosso A, Galluccio F, Tai G, Sigismondi F, Passalacqua M, et al. Efficacy of a tailored rehabilitation program for systemic sclerosis. Clin Exp Rheumatol. 2009;27(3, Suppl 54):S44-50. PMid:19796561.

28. Maddali Bongi S, Landi G, Galluccio F, Del Rosso A, Sigismondi F, Miniati I, et al. The rehabilitation of facial involvement in systemic sclerosis: efficacy of the combination of connective tissue massage, Kabat's technique and kinesitherapy: a randomized controlled trial. Rheumatol Int. 2011;31(7):895-901. https://doi.org/10.1007/s00296-010-1382-9. PMid:20238221.

29. Schouffoer AA, Ninaber MK, Beaart-van de Voorde LJJ, van der Giesen FJ, de Jong Z, Stolk J, et al. Randomized comparison of a multidisciplinary team care program with usual care in patients with systemic sclerosis. Arthritis Care Res (Hoboken). 2011;63(6):909-17. https://doi.org/10.1002/acr.20448. PMid:21312348.

30. Yuen HK, Marlow NM, Reed SG, Mahoney S, Summerlin LM, Leite R, et al. Effect of orofacial exercises on oral aperture in adults with systemic sclerosis. Disabil Rehabil. 2012;34(1):84-9. https://doi.org/10.3109/09638288.2011.587589. PMid:21951278.

31. Baldrighi SEZM, Almeida LF, Lima MC, César CPHAR, Macieira JC. Impacto da intervenção fonoaudiológica na esclerose sistêmica. Distúrb Comum. [Internet]. 2014 [citado em 2025 Maio 28];26(3):596-605. Disponível em: https://revistas.pucsp.br/index.php/dic/article/view/17183/15232

32. Maddali Bongi S, Landi G, Galluccio F, Del Rosso A, Sigismondi F, Miniati I, et al. Rehabilitation of temporomandibular joint (TMJ) in patients with systemic sclerosis (SSC). A comparison between two protocols: preliminary results. Ann Rheum Dis. 2014;73(Suppl 2):1172-3. https://doi.org/10.1136/annrheumdis-2014-eular.4505.

33. Rannou F, Boutron I, Mouthon L, Sanchez K, Tiffreau V, Hachulla E, et al. Personalized physical therapy versus usual care for patients with systemic sclerosis: a randomized controlled trial. Arthritis Care Res (Hoboken). 2017;69(7):1050-9. https://doi.org/10.1002/acr.23098. PMid:27696703.

34. Uras C, Mastroeni S, Tabolli S, Masini C, Pallotta S, Teofoli P, et al. A comparison between two educational methods in the rehabilitation of the microstomia in systemic sclerosis: a randomized controlled trial. Clin Rehabil. 2019;33(11):1747-56. https://doi.org/10.1177/0269215519858395. PMid:31216880.

35. Melchiorre D, Passalacqua M, Maresca M, Landi G, Bagni MA, El Aoufy K, et al. The effect of a combined rehabilitation program on the temporomandibular joint in systemic sclerosis evaluated by ultrasound exam. J Ultrasound. 2024;27(2):297-302. https://doi.org/10.1007/s40477-023-00839-8. PMid:38097897.

36. Baldrighi SEZM, Almeida LF, Alves CS, Silva AKA, Barros L Fo, Macieira JC, et al. Amplitude máxima da abertura de boca na esclerose sistêmica. Distúrb Comun. 2016 [citado em 2025 Maio 28];28(1):162-70. Disponível em: https://revistas.pucsp.br/index.php/dic/article/view/23832

37. Bianchini EMG. Mastigação e ATM: avaliação e terapia. In: Marchesan IQ, organizador. Fundamentos em fonoaudiologia – aspectos clínicos da motricidade oral. 2. ed. Rio de Janeiro: Guanabara Koogan; 2005. p. 37-49.

38. Sharma M, Fadl A, Leask A. Orofacial complications of the connective tissue disease systemic sclerosis. J Dent Res. 2024;103(7):689-96. https://doi.org/10.1177/00220345241249408. PMid:38779873.

39. Sabino CP, Silva DFT, Ribeiro MS. Conceitos físicos aplicados à fotobiomodulação. In: Mouffron V, Alves GÂ, Motta AR, Silva HJ, editores. Fotobiomodulação aplicada à Fonoaudiologia. Carapicuíba: Pró-Fono; 2022. p. 3-22.

40. Vangipuram R, Feldman SR. Ultraviolet phototherapy for cutaneous diseases: a concise review. Oral Dis. 2016;22(4):253-9. https://doi.org/10.1111/odi.12366. PMid:26464123.

41. Demir MG. Investigation of maximum mouth opening in terms of age, weight, height and body mass index in Turkish adult population. Cranio. 2025;43(4):571-6. PMid:37343049.

42. Wat H, Wu DC, Rao J, Goldman MP. Application of intense pulsed light in the treatment of dermatologic disease: a systematic review. Dermatol Surg. 2014;40(4):359-77. https://doi.org/10.1111/dsu.12424. PMid:24495252.

43. Sutter E, Giacomelli-Hiestand B, Rücker M, Valdec S. CO2 laser application in stomatology. Swiss Dent J. 2019;129(3):214-5. https://doi.org/10.61872/sdj-2019-03-03. PMid:30932397.

44. Brasil. CFFa: Conselho Federal de Fonoaudiologia. Resolução CFFa nº 606, de 17 de março de 2021. Dispõe sobre o uso da terapia por fotobiomodulação como recurso terapêutico por fonoaudiólogos. Diário Oficial da União [Internet]; Brasília; 2021 [acesso em 2025 Maio 23]. Disponível em: https://www.fonoaudiologia.org.br/resolucoes/resolucoes_html/CFFa_N_606_21.htm

45. Fujita RLR, Hurtado CCN. Aspectos relevantes do uso da toxina botulínica no tratamento estético e seus diversos mecanismos de ação. Saber Cient. 2021;8(1):120-33. https://doi.org/10.22614/resc-v8-n1-1069.

46. Floris P. Utilização do ácido hialurónico como coadjuvante ao tratamento periodontal não cirúrgico [dissertação]. Porto: Universidade Fernando Pessoa; 2019 [citado em 2025 Maio 28]. Disponível em: https://www.proquest.com/openview/34e5a77265c215a1694eae4bddfa1adb/1?pq-origsite=gscholar&cbl=2026366&diss=y

47. Vasconcelos SCB, Nascente FM, Souza CMD, Rocha Sobrinho HM. O uso do ácido hialurônico no rejuvenescimento facial. Rev Bras Mil Cienc. 2020;6(14):8-15. https://doi.org/10.36414/rbmc.v6i14.28.

48. Dantas SFIM, Lopes FP, Pinto ISVN, Lira MR. As eficácias a curto e longo prazo do preenchimento com ácido hialurônico no rejuvenescimento facial. Saúde Ciênc Ação. [Internet]. 2019 [citado em 2025 Maio 28];5(1):63-81. Disponível em: https://unifan.edu.br/revistas/index.php/RevistaICS/article/view/516

49. Santos GA, Moreira SR, Santos DFC, Santos FR, Teixeira-Coelho F. Efeito do alongamento estático pré-exercício pliométrico sobre marcadores indiretos de danos musculares. Rev Bras Fisiol Exerc. 2021;20(2):165-76. https://doi.org/10.33233/rbfex.v20i2.4146.

50. Câmara-Gomes LF, Dibai Filho AV, Diniz RR, Alvares PD, Veneroso CE, Cabido CET. Mecanismos de exercícios de alongamento muscular para redução de dor lombar: revisão narrativa. BrJP. 2022;5(1):52-5. https://doi.org/10.5935/2595-0118.20220001.

51. Torres GMX, César CPHAR. Fisiologia do exercício na motricidade orofacial: conhecimento sobre o assunto. Rev CEFAC. 2019;21(1):e14318. https://doi.org/10.1590/1982-0216/201921114318.

52. Vitali C, Baldanzi C, Polini F, Montesano A, Ammenti P, Cattaneo D. Instrumented assessment of oral motor function in healthy subjects and people with systemic sclerosis. Dysphagia. 2015 Jun;30(3):286-95. https://doi.org/10.1007/s00455-015-9597-2. PMid:25687967.

53. Oliveira AB, Ferrisse TM, Salomão KB, Miranda ML, Bufalino A, Brighenti FL. Photobiomodulation in the treatment of xerostomia associated with hyposalivation in a pediatric patient with systemic scleroderma. Autops Case Rep. 2021;11:e2020220. https://doi.org/10.4322/acr.2020.220. PMid:34277488.

54. Dimer NA, Rasquinha GN, Goulart BNGR. Roteiro pré, durante e pós teleconsulta fonoaudiológica – o que aprendemos com a pandemia da COVID-19. Rev CEFAC. 2022;24(4):e3722. https://doi.org/10.1590/1982-0216/20222443722s.

55. Türk İ, Cüzdan N, Çiftçi V, Arslan D, Ünal İ. Correlations between clinical features and mouth opening in patients with systemic sclerosis. Arch Rheumatol. 2020;35(2):196-204. https://doi.org/10.46497/ArchRheumatol.2020.7434. PMid:32851368.